*What is claimed is:*

Sub B1

~~1. A transducer for converting from electrical energy to mechanical energy, the transducer comprising:~~

~~at least two electrodes; and~~

~~a polymer arranged in a manner which causes a portion of the polymer to deflect in response to a change in electric field, wherein a portion of the polymer is elastically pre-strained.~~

2. The transducer of claim 1 wherein the transducer has a maximum linear strain of at least about 50 percent in response to the change in electric field.

3. The transducer of claim 1 wherein the transducer has a maximum linear strain of at least about 100 percent in response to the change in electric field.

4. The transducer of claim 1 wherein the transducer has a maximum area strain of at least about 100 percent in response to the change in electric field.

5. The transducer of claim 1 wherein the pre-strain is applied to a first orthogonal direction at a pre-strain greater than pre-strain in a second orthogonal direction.

6. The transducer of claim 5 wherein the pre-strain applied to the first orthogonal direction is used to enhance deflection in the second orthogonal direction.

Sub B2

7. The transducer of claim 6 wherein the polymer is pre-strained by a factor in the range of about 1.5 times to 50 times the original area.

8. The transducer of claim 1 wherein the polymer comprises one of a silicone rubber and an acrylic.

9. The transducer of claim 1 further comprising a barrier layer.

10. The transducer of claim 1 wherein the polymer comprises a textured surface.

11. The transducer of claim 1 wherein the polymer has a thickness between about 1 micrometer and 2 millimeters.

12. The transducer of claim 1 wherein the polymer is one of a commercially available silicone elastomer, polyurethane, PVDF copolymer or adhesive elastomer.

13. The transducer of claim 1 wherein the change in electric field is at most about 440 MegaVolts/meter.

14. The transducer of claim 1 wherein the polymer has a maximum actuation pressure between about 0.1 Pa and about 10 MPa.

15. The transducer of claim 1 wherein the polymer has an operational frequency less than about 100 kHz.

16. The transducer of claim 1 wherein the polymer has an elastic modulus below about 100 MPa.

17. The transducer of claim 1 wherein the portion of the polymer deflects out of the plane of the polymer in response to the change in electric field.

18. The transducer of claim 1 further comprising a stiff member attached to a portion of the polymer.

19. The transducer of claim 18 wherein the stiff member is included in a frame.

20. The transducer of claim 1 wherein one of the at least two electrodes is compliant.

21. The transducer of claim 1 further comprising a second polymer arranged in a manner which causes a portion of the second polymer to deflect in response to a second change in electric field and the second polymer is coupled to the first pre-strained polymer.

22. The transducer of claim 21 wherein the second polymer is mechanically coupled to the first polymer such that they have the same deflection.

23. The transducer of claim 1 wherein the transducer is included in an artificial muscle.

24. A transducer for converting electrical energy to mechanical energy, the transducer comprising:

at least two electrodes; and

a polymer arranged in a manner which causes a portion of the polymer to deflect in response to a change in electric field provided by the at least two electrodes, wherein the portion deflects with a maximum linear strain between about 50 percent and about 215 percent in response to the change in electric field.

25. The transducer of claim 24 wherein the polymer comprises one of a silicone rubber and an acrylic.

26. The transducer of claim 24 wherein the polymer is one of a commercially available silicone elastomer, polyurethane, PVDF copolymer or adhesive elastomer.

27. An actuator for converting electrical energy into displacement in a first direction, the actuator comprising:

at least one transducer, each transducer comprising:

at least two electrodes, and

a polymer arranged in a manner which causes a portion of the polymer to deflect in response to a change in electric field; and

a flexible frame coupled to the polymer, the frame providing mechanical assistance to improve displacement in the first direction.

28. The actuator of claim 27 wherein the mechanical assistance comprises a set of springs.

29. The actuator of claim 27 wherein the mechanical assistance changes the resting position of the actuator.

30. The actuator of claim 27 wherein the polymer comprises pre-strain.

31. The actuator of claim 30 wherein the polymer comprises pre-strain in a second direction which improves displacement in the first direction.

32. The actuator of claim 31 wherein the actuator contracts in the second direction in response to the electric field.

33. The actuator of claim 32 wherein the flexible frame couples polymer deflection in the second direction into displacement in the first direction.

34. An actuator for converting electrical energy into mechanical energy, the actuator comprising a flexible member having fixed end and a free end, the flexible member comprising at least two electrodes and a pre-strained polymer arranged in a manner which causes a portion of the polymer to deflect in response to a change in electric field provided by the at least two electrodes.

35. The actuator of claim 34 wherein the flexible member is a second transducer.

36. The actuator of claim 35 wherein the free end has two degrees of freedom.

37. The actuator of claim 34 wherein the flexible member has a stiffness greater than the polymer.

38. An actuator for converting electrical energy into displacement in a first direction, the actuator comprising:

at least one transducer, each transducer comprising:

at least two electrodes, and

a polymer arranged in a manner which causes a portion of the polymer to deflect in response to a change in electric field; and

at least one stiff member coupled to the at least one transducer, the at least one stiff member substantially preventing displacement in a second direction.

39. The actuator of claim 38 wherein the polymer has a compliance in one direction greater than in a second.

40. The actuator of claim 38 wherein the polymer has an aspect ratio of at least 4:1.

41. A diaphragm actuator for converting electrical energy into mechanical energy, the actuator comprising:

at least one transducer, each transducer comprising:

at least two electrodes, and

a pre-strained polymer arranged in a manner which causes a first portion of the polymer to deflect in response to a change in electric field; and

a frame attached to a second portion of the polymer, the frame comprising at least one circular hole, wherein the first portion deflects out of the plane of the at least one circular hole in response to the change in electric field.

42. The actuator of claim 41 further comprising a bias pressure added to a first side of the polymer.

43. The actuator of claim 42 wherein the bias pressure is provided by a swelling agent.

44. The actuator of claim 41 wherein the diaphragm actuator is included in a pump.

45. The actuator of claim 41 wherein the first portion deflects at least partially through the hole.

46. The actuator of claim 45 wherein the first portion deflects at least partially through the hole to a height greater than half the hole diameter.

47. The actuator of claim 41 wherein the diaphragm actuator is used to provide linear output.

48. The actuator of claim 41 wherein the diaphragm actuator is included in an array of diaphragm actuators.

49. An actuator for converting electrical energy into mechanical energy, the actuator comprising a body having at least one degree of freedom between a first body portion and a second body portion, the body including at least one transducer attached to the first portion and the second portion, each transducer comprising at least two electrodes and a pre-strained polymer arranged in a manner which causes a portion of the polymer to deflect in response to a change in electric field; the actuator also comprising a first clamp attached to the first body portion and a second clamp attached to the second body portion.

50. The actuator of claim 49 wherein the polymer is rolled.

51. The actuator of claim 49 wherein the first and second clamps are electrostatic clamps.

52. An actuator for converting electrical energy to mechanical energy, the actuator comprising a transducer, the transducer comprising a polymer arranged in a manner which causes a first portion of the polymer to deflect in response to a change in electric field, a first electrode pair configured to actuate a second portion of the polymer and a second electrode pair configured to actuate a third portion of the polymer, the actuator also comprising an output member coupled to a first portion of the polymer.